WHAT IS CLAIMED IS:

1. A magnetic sensor comprising:

a fixed magnetic layer containing first and second magnetic layers and a non-magnetic interlayer interposed therebetween;

a free magnetic layer laminated thereto;

a non-magnetic material layer interposed between the fixed magnetic layer and the free magnetic layer; and

a non-magnetic metal layer containing an X-Mn alloy (where X is at least one element selected from the group consisting of Pt, Pd, Ir, Rh, Ru, Os, Ni, and Fe),

wherein the first magnetic layer is disposed farther from the non-magnetic material layer than the second magnetic layer, and the first magnetic layer is in contact with the non-magnetic metal layer,

a crystal of the non-magnetic metal layer and a crystal of the first magnetic layer are oriented in an epitaxial state or a heteroepitaxial state, and

the fixed magnetic layer has an open end surface at a face configured to oppose a recording medium.

2. The magnetic sensor according to Claim 1,

wherein the non-magnetic metal layer has a face-centered cubic (fcc) structure at least in the vicinity of an interface at a first magnetic layer side of the fixed magnetic layer, in which equivalent crystal planes represented by a {111} plane are oriented in a direction

parallel to the interface.

3. The magnetic sensor according to Claim 1, wherein the non-magnetic metal layer has a thickness of about 5 to 50 Å.

4. The magnetic sensor according to Claim 1, wherein an X element content of the X-Mn alloy is about 55 to 99 atomic percent.

5. The magnetic sensor according to Claim 1, further comprising bias layers on side portions of the free magnetic layer and the fixed magnetic layer, the bias layers supplying a longitudinal bias magnetic field to the free magnetic layer.

6. The magnetic sensor according to Claim 1, wherein the first magnetic layer of the fixed magnetic layer has a face-centered cubic (fcc) structure at least in the vicinity of an interface at a non-magnetic metal layer side, in which equivalent crystal planes represented by a {111} plane are oriented in a direction parallel to the interface.

7. The magnetic sensor according to Claim 6, wherein the first magnetic layer of the fixed magnetic layer comprises Co or Co_xFe_y (where $y \leq$ about 20 and $x+y=$ about 100).

8. The magnetic sensor according to Claim 1,

wherein the first magnetic layer of the fixed magnetic layer has a body-centered cubic (bcc) structure at least in the vicinity of an interface at a non-magnetic metal layer side, in which equivalent crystal planes represented by a {110} plane are oriented in a direction parallel to the interface.

9. The magnetic sensor according to Claim 8,

wherein the first magnetic layer of the fixed magnetic layer comprises Co_xFe_y (where $y \geq$ about 20 and $x+y=$ about 100).

10. The magnetic sensor according to Claim 1,

wherein the first magnetic layer of the fixed magnetic layer in the vicinity of an interface at a non-magnetic metal layer side has a face-centered cubic (fcc) structure in which equivalent crystal planes represented by a {111} plane are oriented in a direction parallel to the interface at the non-magnetic metal layer side, and

the first magnetic layer of the fixed magnetic layer in the vicinity of an interface at a non-magnetic interlayer side has a body-centered cubic (bcc) structure in which equivalent crystal planes represented by a {110} plane are oriented in a direction parallel to the interface at the non-magnetic interlayer side.

11. The magnetic sensor according to Claim 10,

wherein the first magnetic layer of the fixed magnetic layer comprises Co or Co_xFe_y (where $y \leq$ about 20 and $x+y=$ about 100) in the vicinity of the interface at the non-magnetic metal layer side and comprises Co_xFe_y (where $y \geq$ about 20 and $x+y=$ about 100) in the vicinity of the interface at the non-magnetic interlayer side.

12. The magnetic sensor according to Claim 11,

wherein an Fe content of the first magnetic layer of the fixed magnetic gradually increases from the interface at the non-magnetic metal layer side to the interface at the non-magnetic interlayer side.

13. The magnetic sensor according to Claim 1,

wherein a difference of a nearest interatomic distance between the non-magnetic metal layer and the first magnetic layer of the fixed magnetic layer in a plane parallel to an interface therebetween, divided by the nearest interatomic distance of the first magnetic layer, is about 0.05 to 0.20.

14. The magnetic sensor according to Claim 1,

wherein the first magnetic layer comprises a magnetic material having a positive magnetostriction constant.

15. The magnetic sensor according to Claim 1, further comprising electrode layers composed of a film of Cr, α-Ta, or Rh on side portions of the free magnetic layer, the non-magnetic material layer, and the fixed magnetic layer.

16. The magnetic sensor according to Claim 15, wherein a spacing of a crystal lattice of the electrode layers in a direction parallel to a surface of the film is: at least about 0.2044 nm if the electrode layers are composed of Cr, at least about 0.2337 nm if the electrode layers are composed of α-Ta, and at least about 0.2200 nm if the electrode layers are composed of Rh.

17. The magnetic sensor according to Claim 1, wherein the fixed magnetic layer has an optical track width dimension of at most about 0.15 μm.

18. The magnetic sensor according to Claim 1, wherein at least one of the first and second magnetic layers comprise a plurality of sublayers, the plurality of sublayers including a bcc magnetic sublayer provided at a non-magnetic interlayer side and, if the first magnetic layer contains the plurality of sublayers, an fcc magnetic sublayer provided at a non-magnetic metal layer side, or if the second magnetic layer contains the plurality of sublayers, an fcc magnetic sublayer provided at a non-magnetic material layer side.

19. The magnetic sensor according to Claim 1, wherein the second magnetic layer in the vicinity of an interface at a non-magnetic material layer side has a face-centered cubic (fcc) structure in which equivalent crystal

planes represented by a {111} plane are oriented in a direction parallel to the interface at the non-magnetic material layer side, and

the second magnetic layer in the vicinity of an interface at a non-magnetic interlayer side has a body-centered cubic (bcc) structure in which equivalent crystal planes represented by a {110} plane are oriented in a direction parallel to the interface at the non-magnetic interlayer side.

20. The magnetic sensor according to claim 1, further comprising a seed layer containing NiFe alloy, NiFeCr alloy, Cr, or Ta and having a thickness of about 35 Å to 60 Å and on which the nonmagnetic metal layer, the fixed magnetic layer, the free magnetic layer, and the nonmagnetic conductive layer are disposed.

21. A magnetic sensor comprising:

a free magnetic layer;

a non-magnetic metal layer containing an X-Mn alloy (where X is at least one element selected from the group consisting of Pt, Pd, Ir, Rh, Ru, Os, Ni, and Fe);

a fixed magnetic layer in contact with the non-magnetic metal layer and having an open end surface at a face configured to oppose a recording medium, the first magnetic layer containing first and second magnetic layers and a non-magnetic interlayer interposed therebetween; and

a non-magnetic material layer interposed between the

fixed magnetic layer and the free magnetic layer;

wherein a difference of a nearest interatomic distance between the non-magnetic metal layer and the first magnetic layer of the fixed magnetic layer in a plane parallel to an first interface therebetween, divided by the nearest interatomic distance of the first magnetic layer, is about 0.05 to 0.20, and

an end face of the fixed magnetic layer is open and is configured to oppose a face of a recording medium.

22. The magnetic sensor according to Claim 21, wherein the non-magnetic metal layer has a thickness of about 5 to 50 Å.

23. The magnetic sensor according to claim 21, wherein the first magnetic layer has a thickness of about 10 Å to 30 Å, and the second magnetic layer has a thickness of about 15 Å to 35 Å.

24. The magnetic sensor according to claim 21, wherein the nonmagnetic metal layer and the first magnetic layer have crystalline lattice of the same type at the first interface.

25. The magnetic sensor according to claim 24, wherein the type of crystalline lattice of at least one of the nonmagnetic metal layer and the first magnetic layer remains the same throughout the at least one of the

nonmagnetic metal layer and the first magnetic layer.

26. The magnetic sensor according to claim 21, wherein the nonmagnetic metal layer and the first magnetic layer have different types of crystalline lattices at the first interface.

27. The magnetic sensor according to claim 26, wherein the type of crystalline lattice of at least one of the nonmagnetic metal layer and the first magnetic layer remains the same throughout the at least one of the nonmagnetic metal layer and the first magnetic layer.

28. The magnetic sensor according to claim 21, wherein the composition of the first magnetic layer gradually changes between the first interface and a second interface between the first magnetic layer and the nonmagnetic interlayer.

29. The magnetic sensor according to claim 21, wherein the first magnetic layer comprises a magnetic material having a positive magnetostriction constant.

30. The magnetic sensor according to claim 21, further comprising bias layers to supply the free magnetic layer with a longitudinal bias magnetic field, the bias layers being disposed at side ends of the free magnetic layer and the fixed magnetic layer, a thickness of the bias layers

being about 100 to 400 Å.

31. The magnetic sensor according to claim 21, wherein a magnetostriction constant λ of the free magnetic layer is about $-0.5\times10^{-6}\geq \lambda \geq-8\times10^{-6}$.

32. The magnetic sensor according to claim 21, wherein an Fe content of at least one of the first and second magnetic layers gradually varies such that the at least one of the first and second magnetic layers has a bcc structure in the vicinity of an interface at the non-magnetic interlayer side and: if the first magnetic layer has an fcc structure, in the vicinity of an interface at a non-magnetic metal layer side of the first magnetic layer; if the second magnetic layer has an fcc structure, in the vicinity of an interface at a non-magnetic material layer side of the second magnetic layer.

33. The magnetic sensor according to claim 32, wherein if the Fe content of the first magnetic layer varies, the first magnetic layer in the vicinity of the interface at the non-magnetic metal layer side is Co or fcc CoFe and in the vicinity of the interface at the non-magnetic interlayer side the first magnetic layer 23a is bcc CoFe.

34. The magnetic sensor according to claim 21, wherein an optical track width of the fixed magnetic layer is at most about 0.15 μm.

35. The magnetic sensor according to claim 21, wherein a thickness of the non-magnetic material layer is between about 17 to 30 Å and a thickness of the free magnetic layer is about 20 to 60 Å.

36. The magnetic sensor according to claim 21, further comprising a seed layer containing NiFe alloy, NiFeCr alloy, Cr, or Ta and having a thickness of about 35 Å to 60 Å and on which the nonmagnetic metal layer, the fixed magnetic layer, the free magnetic layer, and the nonmagnetic material layer are disposed.

39. The magnetic sensor according to claim 21, wherein at least one of the first and second magnetic layers comprise a plurality of layers, the plurality of layers including a bcc magnetic layer provided at a non-magnetic interlayer side and, if the first magnetic layer contains the plurality of layers, an fcc magnetic layer provided at a non-magnetic metal layer side, or if the second magnetic layer contains the plurality of layers, an fcc magnetic layer provided at a non-magnetic material layer side.

40. The magnetic sensor according to claim 21, wherein an X element content of the X-Mn alloy is about 55 to 99 atomic percent.

41. The magnetic sensor according to claim 21, further

comprising electrode layers composed of a film of Cr, α-Ta, or Rh on side portions of the free magnetic layer, the non-magnetic material layer, and the fixed magnetic layer, a thickness of the electrode layers being about 400 to 1,500 Å.

42. A method of forming a magnetic sensor, the method comprising:

providing a nonmagnetic metal layer containing an X-Mn alloy (where X is at least one element selected from the group consisting of Pt, Pd, Ir, Rh, Ru, Os, Ni, and Fe);

forming a fixed magnetic layer including first and second magnetic layers with a nonmagnetic interlayer disposed therebetween such that the first magnetic layer is in contact with the non-magnetic metal layer and crystals in the nonmagnetic metal layer and crystals in the first magnetic layer are oriented in an epitaxial or a heteroepitaxial state;

forming a free magnetic layer;

forming a nonmagnetic material layer disposed between the fixed magnetic layer and the free magnetic layer such that the first magnetic layer is disposed farthest from the nonmagnetic material layer; and

opening an end face of the fixed magnetic layer, the end face being configured to oppose a face of a recording medium.

43. The method according to claim 42, wherein a temperature of a substrate on which the fixed magnetic layer and the nonmagnetic metal layer are formed is higher during

deposition of the first magnetic layer than during deposition of the nonmagnetic metal layer.

44. The method according to claim 42, further comprising annealing the nonmagnetic metal layer, the fixed magnetic layer, the free magnetic layer, and the nonmagnetic material layer at at least about 290°C for at least about four hours.

45. The method according to claim 42, further comprising varying the composition of the first magnetic layer such that the composition gradually changes between a first interface between the nonmagnetic metal layer and the first magnetic layer and a second interface between the first magnetic layer and the nonmagnetic interlayer.

46. The method according to claim 45, further comprising gradually increasing an amount of Fe in the first magnetic layer contains Fe from the first interface to the second interface.

47. The method according to claim 46, wherein the first magnetic layer of the fixed magnetic layer comprises:

in the vicinity of the first interface Co_xFe_y (in which about 20≥y, x+y= about 100, x and y are atomic percent) or Co; and

in the vicinity of the second interface Co_xFe_y (in which y≥ about 20, x+y= about 100, x and y are atomic percent).

48. The method according to claim 42, further comprising forming the nonmagnetic metal layer and the first magnetic layer such that a difference between a nearest interatomic distance of the nonmagnetic metal layer in a plane parallel to a interface between the nonmagnetic metal layer and the first magnetic layer and a nearest interatomic distance of the first magnetic layer of the fixed magnetic layer in the plane parallel to the interface divided by the nearest interatomic distance of the first magnetic layer is in the range of about 0.05 to 0.20.

49. The method according to claim 42, further comprising limiting an optical track width of the fixed magnetic layer to at most about 0.15 μm.

50. The method according to claim 42, further comprising limiting a thickness of the non-magnetic metal layer between about 5 to 50 Å.

51. The method according to claim 42, further comprising applying a uniaxial stress to the fixed magnetic layer in a height direction during deposition or in a heat treatment after deposition, to orient crystal grains in a polycrystalline structure that forms the first magnetic layer into a uniaxial anisotropy.

52. The method according to claim 51, further

comprising applying a magnetic field to the fixed magnetic layer in a height direction during deposition or sequent heat treatment of the fixed magnetic layer.

53. The method according to claim 42, wherein an X element content of the X-Mn alloy is about 55 to 99 atomic percent.